2. RELEVANCE TO PUBLIC HEALTH

2.1 BACKGROUND AND ENVIRONMENTAL EXPOSURES TO TUNGSTEN AND TUNGSTEN COMPOUNDS IN THE UNITED STATES

Tungsten is naturally released to the atmosphere by windblown dusts. Processes of human origin, such as ore processing, hard-metal fabrication, tungsten carbide production and use, and municipal waste combustion release tungsten to the atmosphere. Tungsten naturally enters waterways through the weathering of rocks and soils. Tungsten can be released to surface waters from sources of human origin (e.g., water effluents from tungsten mining). Deposition of tungsten aerosols or dusts from both natural and anthropogenic sources is also source of tungsten in surface waters. Some tungsten compounds are naturally present in soil, but the concentration of tungsten in localized soils can be increased by land application of sewage sludge, fertilizers, municipal solid waste ash, and industrial wastes that contain tungsten, or by deposition of particulate aerosols.

The general population typically has blood levels of 1–6 μg/L and urine levels of 0.085 μgL of tungsten through inhalation of air and consumption of food. The concentration of tungsten in ambient air is <10 ng/m^3. Limited monitoring data for food or drinking water were located in the United States. Levels of tungsten in these media are expected to be low. For example, onions collected from 11 Danish sites contained tungsten at a mean level of 16.7 μg/kg fresh weight. Recently, tungsten was found in the municipal water supply of Fallon, Nevada at a concentration of 25 μg/L and in household water from this community at a concentrations ranging from 0 to 217.3 μg/L. The general population typically has low levels of tungsten in their blood and urine. As part of the National Health and Nutrition Examination Survey (NHANES) conducted between the years 1999 and 2000, the mean concentration of tungsten in urine of 0.085 μg/L (n=2,338; age ≥6 years old) was reported for the U.S. population. Individuals who work in manufacturing, fabricating, and reclaiming industries, especially individuals using hard metal materials or tungsten carbide machining tools, may be exposed to higher levels of tungsten or tungsten compounds than the general population. Occupational exposure is primarily via inhalation of dust particles of elemental (metallic) tungsten and/or its compounds.

2.2 SUMMARY OF HEALTH EFFECTS

Pulmonary fibrosis, memory and sensory deficits, and increased mortality due to lung cancer have been associated with occupational exposure to dusts generated in the hard metal industry. Hard metal is an alloy or encapsulated mixture that is composed of tungsten or tungsten carbide and cobalt (primarily, although the alloys may also contain yttrium, thorium, copper, nickel, iron, or molybdenum). Historically, the respiratory and neurological effects observed in hard metal workers have been attributed to cobalt, not tungsten. However, based on the presence of tungsten oxide fibers in air samples taken at some hard metal facilities and demonstrations that tungsten oxide fibers are capable of generating hydroxyl radicals in human lung cells *in vitro*, it has been suggested that tungsten oxide fibers may contribute to the development of pulmonary fibrosis in hard metal workers.

Limited reports associate tungsten exposure with reproductive and developmental effects such as decreased sperm motility, increased embryotoxicity, and delayed fetal skeletal ossification in animals. However, more detailed accounts of tungsten-induced reproductive and developmental toxicity were not located. Tungsten has been observed to cross the placental barrier and enter the fetus. Dermal or ocular exposure to tungsten may result in localized irritation. No adequate animal data are available to assess the carcinogenic potential of tungsten or tungsten compounds. Tungsten has recently been nominated to the National Toxicology Program (NTP) for toxicological characterization, which includes carcinogenicity testing.

2.3 MINIMAL RISK LEVELS

Inhalation MRLs

No inhalation MRLs were derived for tungsten or tungsten compounds since adequate data were not available for this route of exposure.

Oral MRLs

No oral MRLs were derived for tungsten or tungsten compounds due to a lack of availability of data for this route of exposure. This finding will be evaluated based on a review of several recently translated foreign articles to determine if the data they contain and the scientific method under which they were developed are adequate for MRL derivation.